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A Review on Aluminium Shot Making Machine and its Application

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Abstract— *This paper represents a overview of aluminium shot and aluminium shot making process. It contains a review of development of aluminium shot making machine. This includes a description of the operational principal and performance characteristics of aluminium shot machine and the application of aluminium shot. The design explain below has minimum cost and less space required.*

Keywords— Aluminium shot, Aluminium shot making, deoxidtion, Dripper, heating coil.

I. INTRODUCTION

The Aluminium shot are the fine spherical aggregates of aluminium. Aluminium shot are basically used in degassing process in steel manufacturing industry. Aluminum shot formed by pouring molten aluminum into water is not satisfactory on account of its coarse size and compactness of form, thereby giving slow and incomplete reactions.

The preferable form of aluminum for these reactions is known as grained aluminum, and is produced by breaking up the metal mechanically just as it is passing from the liquid to the solid state.

Also, these are manufactured by melting of primary or secondary aluminium and blown into air or vacuum, or are cast in sand and sieved off. Other methods include casting of molten aluminum in water.

Fig.1: Aluminium shots

The basic steps involve in the manufacturing of aluminum shots are as follows.

1. Melting- Commercial grade aluminum of 99% purity is suitable for manufacturing of shot. The melting is carried out in graphite crucibles in pit type furnace.
2. Casting- Aluminum shot are made by passing molten aluminum at correct temperature through a refractory coated vibratory sieve and then collected in a water tank.
3. Grading- The shots so obtained from the water tank are graded and oversize shot are sent for re-melting.
4. Testing-Then it sends for chemical analysis then material conforming to the standards is weighed and packed.
5. Quality control and standard- Aluminum shot used for deoxidtion of steel should conform to IS: 1253:1965.

The Conventional method used for making aluminium shot are don't produce shot of uniform size and shape, Also the space required for the machine is large, the initial and maintains cost required for the machine is to high.

II. METHODS OF SHOT MAKING

The shot are manufactured by using different methods depending on material and there application.

1. A Shot tower method: - It is a tower designed for the production of shot by freefall of molten material, which is then collect in water basin. This method is invented by William watts of Bristol, UK, and patented in 1782.

In a shot tower, material is heated until it melts, then dropped through copper sieve high in the tower. The liquid material forms tiny spherical balls by surface tension, and then solidifies as it falls. The cooled balls are caught at the floor of the tower in water filled basin. The now fully cooled balls are cheeked for roundness and sorted by size, those are out of round are re -melted. A slightly inclined table is used for checking roundness. To make large shot size a copper sieve with large hole is used. However the maximum size is limited by the height of tower, because of larger shot size must fall to further cool. A polishing with a slight amount of graphite is necessary for prevents oxidation.

2. Rolling method:-In this method Pouring the liquid metal into rotating cylinder, the liquid metal will splash and fall into the water and then from the shot. This method has been eliminated for its poor productivity.

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Fig.2: Rolling drum

3. Centrifugation method: - Pouring the liquid metal into special rotational disc with high speed, under free centrifugal force, the liquid metal will removed from disc and fall into water and from the metal shot. The centrifugation can get higher productivity and greatly reduce the proportion of hollow shot. But the shot produced by this method are not uniform size and shape.

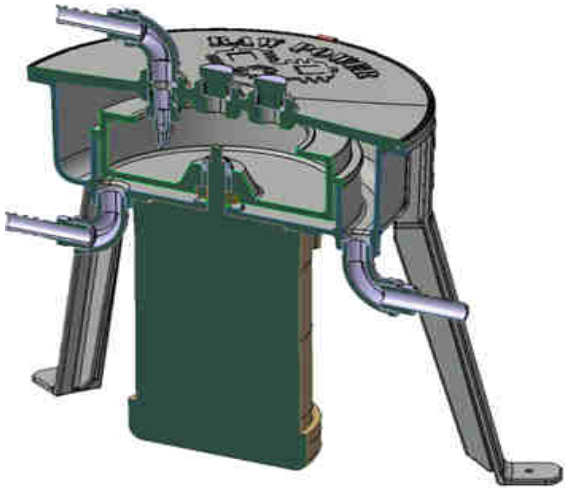

Fig. 3: Centrifugation shot making machine.

4. Water jetting method: - In this method making use of water to jet and hit the liquid metal to scattered into water and then cooling, solidification and finally from the metal shot. Shot coming out of this method easily from hollow shots or shot with irregular shapes. The speed and stress of water jet can be controlled by changing the shape of nozzle and also can greatly improve the product.

5. Rotational centrifugation method:- Rotational centrifugation is a combination of water jet and centrifugation. Put the molten metal into special equipment and rotate it into metal membrane. Under the action of force and surface tension, the metal will form little droplets and drop certainly into water and finally shaped into metal shots. The shots made by this method generally have better quality and mechanical properties.

III. DESIGN OF ALUMINIUM SHOT MAKING MACHINE

In this paper we have focused on solving problem as mentioned above. The aluminium shot machine is basically divided into three part viz upper panel, heating coil and sump.

1. Design of upper panel:-The panel is rectangular in cross section which area is gradually increasing. The front side of the panel consists of number of dripper. The dripper is nothing but hallow bolt, the head of bolt is drilled with hole of required size of shot through which the liquid metal is passed through dripper.

Fig.4: dripper

Then the molten metal is then passes through sprocket provided on expanded plate and then collected into container which is filled with water. By using this method we can get uniform size and shaped shot.

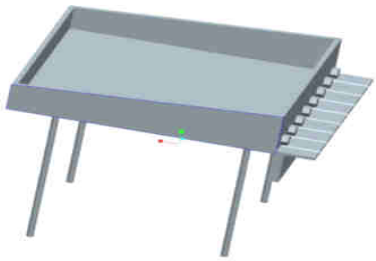

Fig.5: model of upper Panel.

2. Design of sump: - The sump is also rectangular container which is filled with water. In this container the material from dripper is collected which is in circular from that could be solidified by eliminating heat in water. At the bottom of sump tap is provided to remove the heated water after short interval of time. Before the tap mesh is provided to bloke the shot going inside the tap.

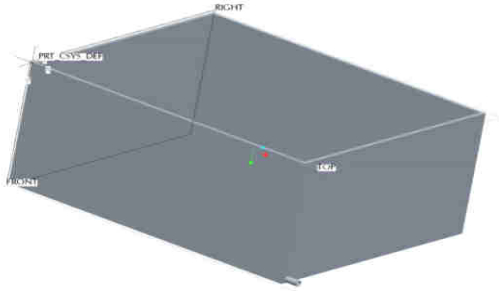

Fig.6: Design of Sump

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3. Design of heating coil: - An induction heating coil is an electrical coil in which the heat is applied by induction heating of metal. Induction coil capacity range from less than one kilogram to one hundred tones capacity and used to melt iron and steel, aluminium Provide.

The heating coil arrangement is provided at the bottom of upper panel. The induction heating coils which can be provide heat to the upper panel up to 700°c. In order to maintain the temperature of aluminium above the solidification temperature.

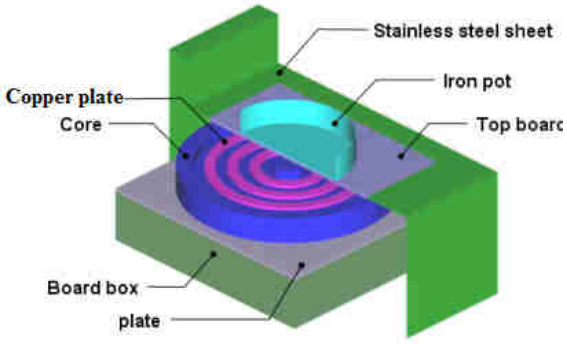

Fig.7: Arrangement of heating coil.

4. Assembly of all part:-In assembly of all part make shore that the distance between dripper and water sump must be more than 1/4 inch. In order to increase the high and give more time for air solidification to get the uniform shape of the shot.

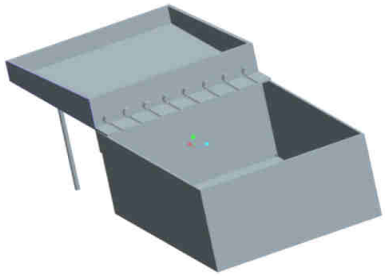

Fig.8: Assembly design

IV. APPLICATION OF ALUMINIUM SHOT

The aluminium shot are used for various application, aluminium shot are basically used for deoxidation purpose in steel processing, eliminating surface defects, cleaning aluminium parts etc. Typical examples of these applications are given as follows:

1. Deoxidizer Application :- Aluminium is used as deoxidant in various forms in making fully aluminium killed steel and also in silicon killed steels.

The liquid steel contains dissolved oxygen after their conversion from molten iron, but the solubility of oxygen in steel decreases with cooling. As steel cools, excess oxygen can cause blowholes or precipitate Feo. This dissolved oxygen can be removed by adding aluminium before casting. The aluminium reacts with the dissolved gas to from aluminium oxide. The aluminium oxide precipitates provide the additional benefit of pinning grain boundaries, thereby preventing grain growth during heat treatment. For steel of the same grade a killed steel will be harder than rimmed steel.

2. Application in Eliminating surface defects:-

The aluminium shot are used to remove the surface defect of product of only die casting defect, something like the flashing, flow- mark, burr, shallow scratch and blister, etc. such type of defect can be remove by aluminium shot blasting method. In this the aluminium shot are blast over the die cast product and respective defect are removed.

3. Application in cleaning aluminium part:- Cleaning engine blocks and cylinder head is just important as the machining operations you will perform on the casting. Checking for crakes in cast iron head and blocks requires a clean surface for the magnetic particle detection powder. For that aluminium shot are used because aluminium is soft material than the cast iron and much sensitive to high temperature. Also the aluminium is more chemically reactive than cast iron for this reason aluminium shot are used for cleaning purpose.

4. Application in matting nonmetal parts:- Aluminium shot are used to joint plastic die casting. To join the different part of nonmetals aluminium shot are used.

V. CONCLUSION

The design explained above will consume less space and the initial and maintains cost is less as comparing to other method use for making aluminium shot. This machine we can use for other type of material also by changing the martial used for upper panel. It is can be shifted from one place to another very easily without any damage. The design can be modified further and optimized according to working condition.

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